M74LS669P

SYNCHRONOUS PRESETTABLE UP/DOWN 4-BIT BINARY COUNTER

DESCRIPTION

The M74LS669P is a semiconductor integrated circuit containing a synchronous 4-bit binary counter function with an up/down control input and preset input.

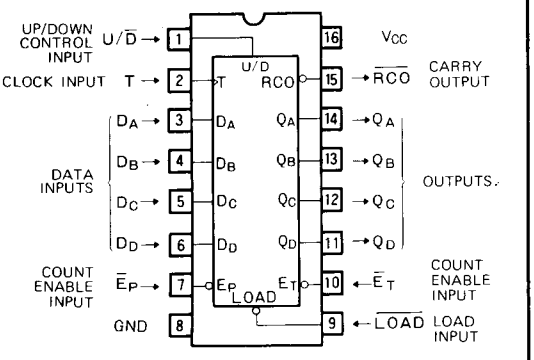
FEATURES

- Fully synchronous operation for counting and programming
- Integral look-ahead for counting
- Carry output for n bit cascading
- Fully independent clock circuit
- Up/down control input provided
- Preset input provided

APPLICATION

General purpose, for use in industrial and consumer equipment

PIN CONFIGURATION (TOP VIEW)



Outline 16P4

FUNCTIONAL DESCRIPTION

This device operates with the preset, up/down control and enable function synchronized to the rising edge of the clock pulse.

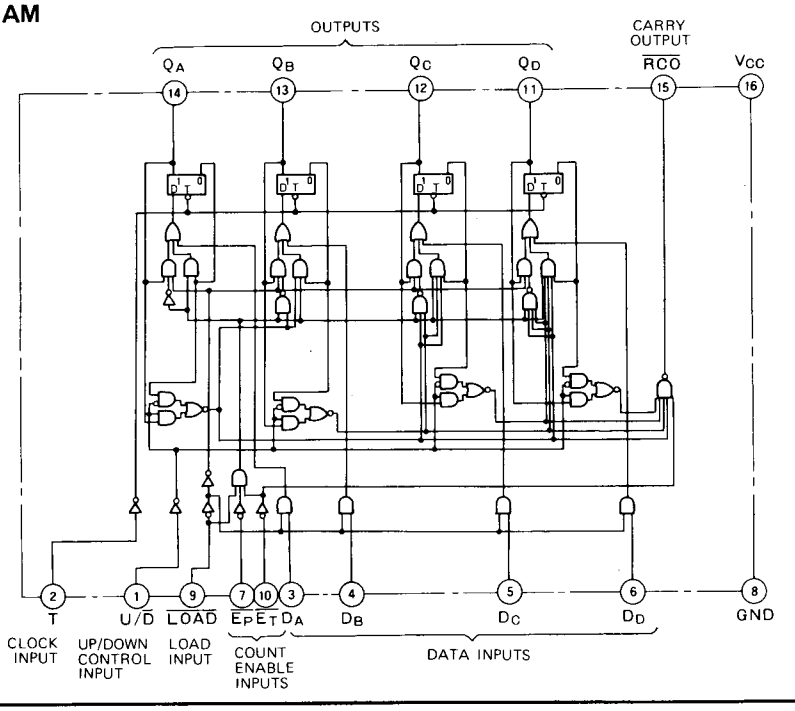
Data is acquisitioned from outputs Q_A thru Q_D on the rising edge of clock input T, synchronized with (and in response to) data input at D_A thru D_D; and occurs after preset is initiated by dropping load input ($\overline{LOAD}$) to a low-level.

Up/down counter operations are initiated when $\overline{LOAD}$ is high-level, and the count enable input ($\overline{E_P}$ and $\overline{E_T}$) is low-level. The counter increments (up) when control input U/$\overline{D}$ is high-level, and decrements (down) at low-level.

Carry output ($\overline{RCO}$) goes low-level (active) at 15_2 during up operations, and at 0_2 while the count is going down. The synchronous feature of the counter permits it to be cascaded for use as a binary counter. (See the application example given for M74LS668P.)

Counter operations are inhibited when $\overline{LOAD}$ and ($\overline{E_P}$ or $\overline{E_T}$) are all high-level.

BLOCK DIAGRAM



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SYNCHRONOUS PRESETTABLE UP/DOWN 4-BIT BINARY COUNTER

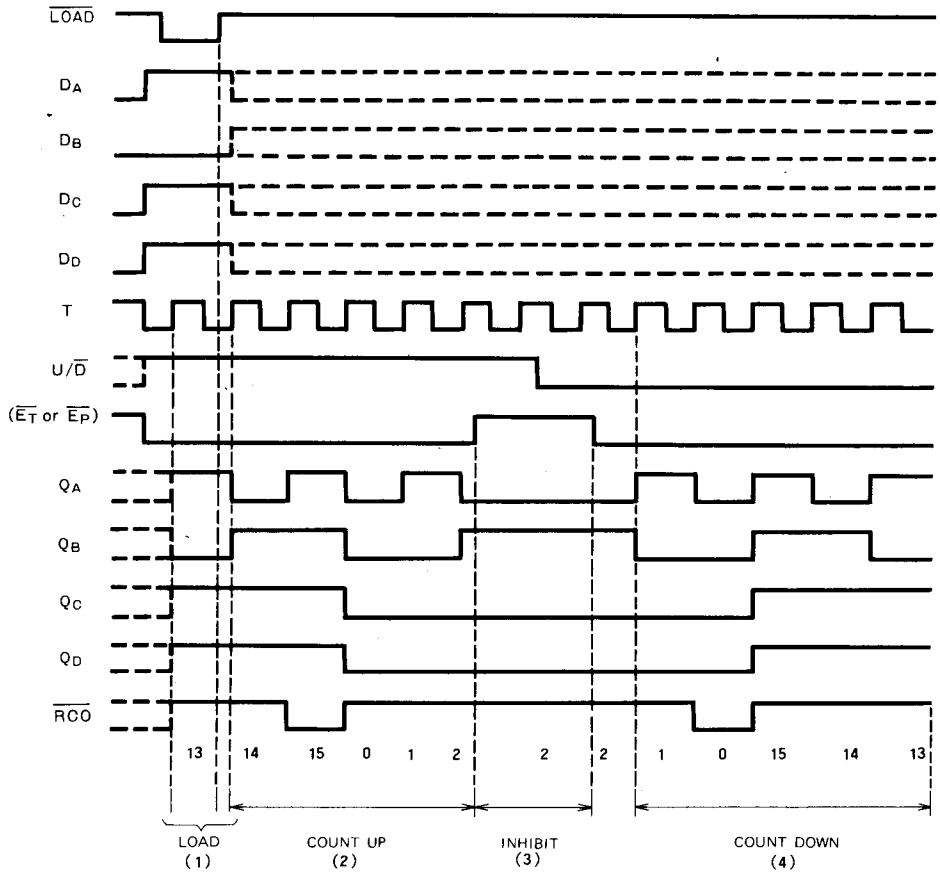
FUNCTION TABLE (Note 1)

$\overline{LOAD}$	$\overline{E_P}$	$\overline{E_T}$	$U/\overline{D}$	T	Q_A	Q_B	Q_C	Q_D	$\overline{RCO}$*
L	X	X	X	↑	D_A	D_B	D_C	D_D	H
H	L	L	H	↑	COUNT UP				H
H	L	L	L	↑	COUNT DOWN				H
H	H	X	X	X	COUNT INHIBIT				H
H	X	H	X	X					

Note 1. ↑ : Transition from low to high
X : Irrelevant
* : $\overline{RCO}$ is normally at high-level, however, when $\overline{E_T}$ is low and the counter is incrementing, Q_A, Q_B, Q_C and Q_D will be high, and $\overline{RCO}$ will be low. Also, when the counter is decrementing, Q_A, Q_B, Q_C and Q_D will be low, and $\overline{RCO}$ will also be low.

$$\overline{RCO} = Q_A \cdot Q_B \cdot Q_C \cdot Q_D \cdot (U/\overline{D}) \cdot \overline{E_T}$$
$$\overline{RCO} = \overline{Q}_A \cdot \overline{Q}_B \cdot \overline{Q}_C \cdot \overline{Q}_D (U/\overline{D}) \cdot \overline{E_T}$$

TIMING DIAGRAM



Timing diagram notes:
(1) Preset at 13
(2) Increment at 14, 15, 0, 1, 2
(3) Count inhibit
(4) Decrement at 1, 0, 15, 14, 13

SYNCHRONOUS PRESETTABLE UP/DOWN 4-BIT BINARY COUNTER

ABSOLUTE MAXIMUM RATINGS ($T_a = -20 \sim +75°C$, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		−0.5 ~ +7	V
V_I	Input voltage		−0.5 ~ +15	V
V_O	Output voltage	High-level state	−0.5 ~ V_{CC}	V
Topr	Operating free-air ambient temperature range		−20 ~ +75	°C
Tstg	Storage temperature range		−65 ~ +150	°C

RECOMMENDED OPERATING CONDITIONS ($T_a = -20 \sim +75°C$, unless otherwise noted)

Symbol	Parameter		Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage		4.75	5	5.25	V
I_{OH}	High-level output current	$V_{OH} \geqq 2.7V$	0		−400	μA
I_{OL}	Low-level output current	$V_{OL} \leqq 0.4V$	0		4	mA
		$V_{OL} \leqq 0.5V$	0		8	mA

ELECTRICAL CHARACTERISTICS ($T_a = -20 \sim +75°C$, unless otherwise noted)

Symbol	Parameter		Test conditions		Limits			Unit
					Min	Typ	Max	
V_{IH}	High-level input voltage				2			V
V_{IL}	Low-level input voltage						0.8	V
V_{IC}	Input clamp voltage		V_{CC}=4.75V, I_{IC}=−18mA				−1.5	V
V_{OH}	High-level output voltage		V_{CC}=4.75V, V_I=0.8V, V_I=2V, I_{OH}=−400μA		2.7	3.4		V
V_{OL}	Low-level output voltage		V_{CC}=4.75V, V_I=0.8V, V_I=2V	I_{OL}=4mA		0.25	0.4	V
				I_{OL}=8mA		0.35	0.5	V
I_{IH}	High-level input current	$D_A, D_B, D_C, D_D, \overline{E_P}, U/\overline{D}$	V_{CC}=5.25V, V_I=2.7V				20	μA
		$T, \overline{E_T}$					20	
		$\overline{LOAD}$					40	
		$D_A, D_B, D_C, D_D, \overline{E_P}, U/\overline{D}$	V_{CC}=5.25V, V_I=10V				0.1	mA
		$T, \overline{E_T}$					0.1	
		$\overline{LOAD}$					0.2	
I_{IL}	Low-level input current	$D_A, D_B, D_C, D_D, \overline{E_P}, U/\overline{D}$	V_{CC}=5.25V, V_I=0.4V				−0.4	mA
		$T, \overline{E_T}$					−0.4	
		$\overline{LOAD}$					−0.8	
I_{OS}	Short-circuit output current (Note 2)		V_{CC}=5.25V, V_O=0V		−20		−100	mA
I_{CC}	Supply current		V_{CC}=5.25V (Note 3)			20	34	mA

✱ All typical values are at V_{CC} = 5V, T_a = 25°C.

Note 2. All measurements should be done quickly, and not more than one output should be shorted at a time.

3. I_{CC} is measured after applying a momentary 4.5V, then ground, to the clock input with all other inputs grounded.

SYNCHRONOUS PRESETTABLE UP/DOWN 4-BIT BINARY COUNTER

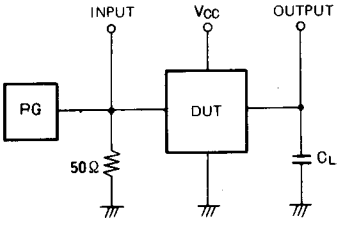
SWITCHING CHARACTERISTICS (V_{CC}=5V, Ta=25°C, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
f_{max}	Maximum clock frequency	C_L=15pF (Note 4)	25	30		MHz
t_{PLH}	Low-to-high-level, high-to-low-level output propagation time, from input T to output $\overline{RCO}$			24	40	ns
t_{PHL}				32	60	
t_{PLH}	Low-to-high-level, high-to-low-level output propagation time, from input T to outputs Q_A, Q_B, Q_C, and Q_D			20	27	ns
t_{PHL}				15	27	
t_{PLH}	Low-to-high-level, high-to-low-level output propagation time, from input $\overline{E_T}$ to output $\overline{RCO}$			10	17	ns
t_{PHL}				28	45	
t_{PLH}	Low-to-high-level, high-to-low-level output propagation time, from input U/$\overline{D}$ to output $\overline{RCO}$			25	35	ns
t_{PHL}				20	40	

TIMING REQUIREMENTS (V_{CC}=5V, Ta=25°C, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
t_w	Clock T pulse width		25	12		ns
$t_{su(D)}$	Setup time D_A~D_D to T		20	18		ns
$t_{su(E)}$	Setup time $\overline{E_T}$, $\overline{E_P}$ to T		35	26		ns
$t_{su(\overline{LOAD})}$	Setup time $\overline{LOAD}$ to T		25	15		ns
$t_{su(U/\overline{D})}$	Setup time U/$\overline{D}$ to T		30	20		ns
t_h	Setup time of all inputs to T		0	−15		ns

Note 4. Measurement Circuit



(1) The pulse generator (PG) has the following characteristics: PRR = 1MHz, t_r = 6ns, t_f = 6ns, t_w = 500ns, V_P = 3V_{P-P}, Z_O = 50Ω.
(2) C_L includes probe and jig capacitance.

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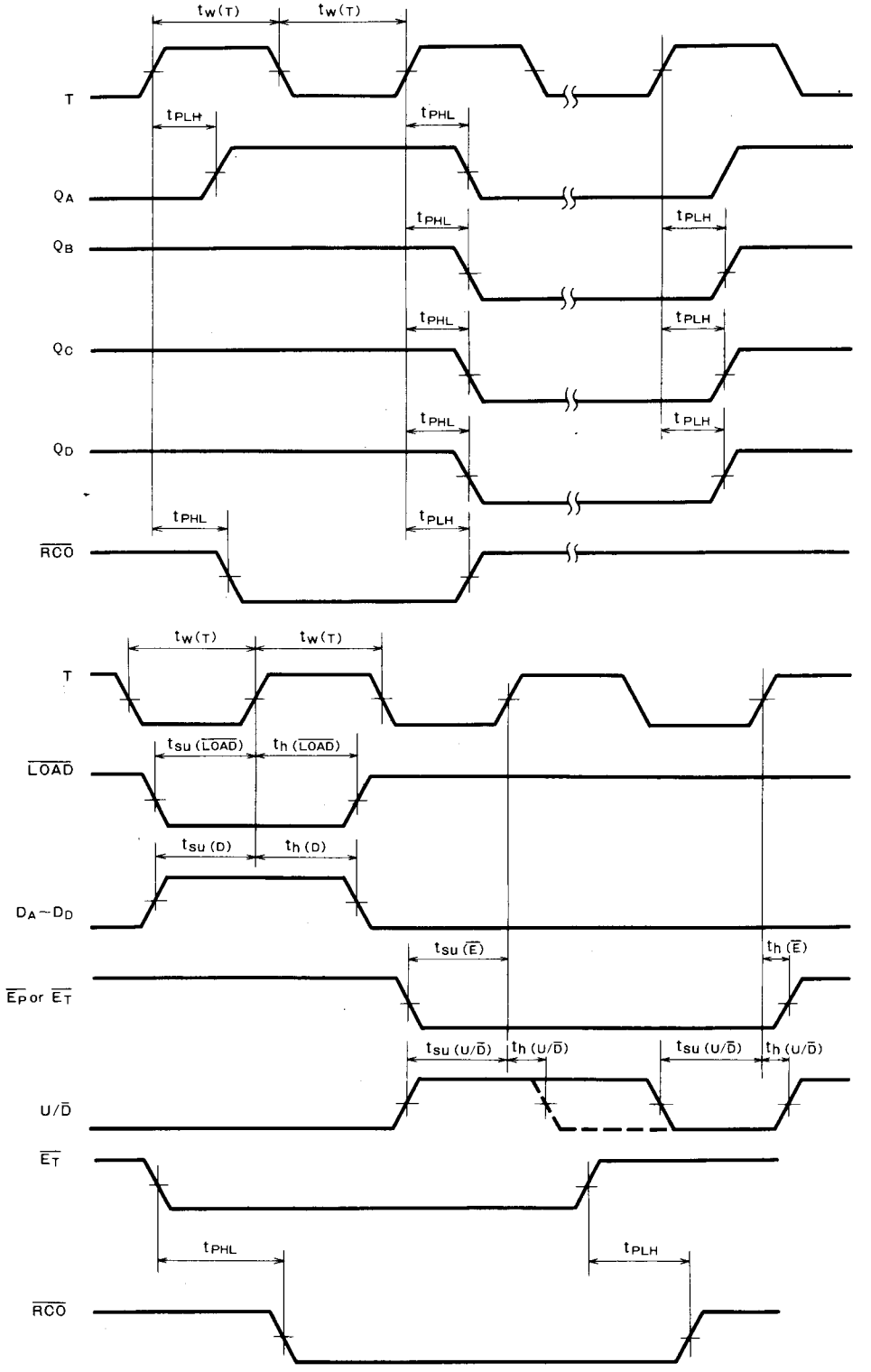
TIMING DIAGRAM (Reference level = 1.3V)



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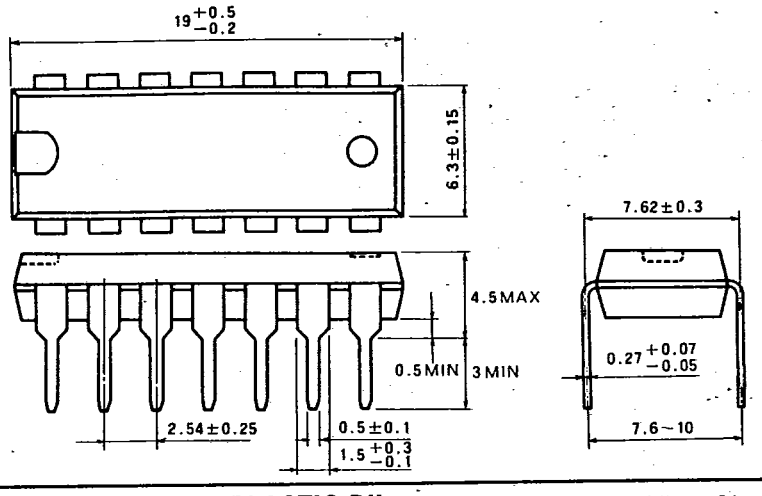
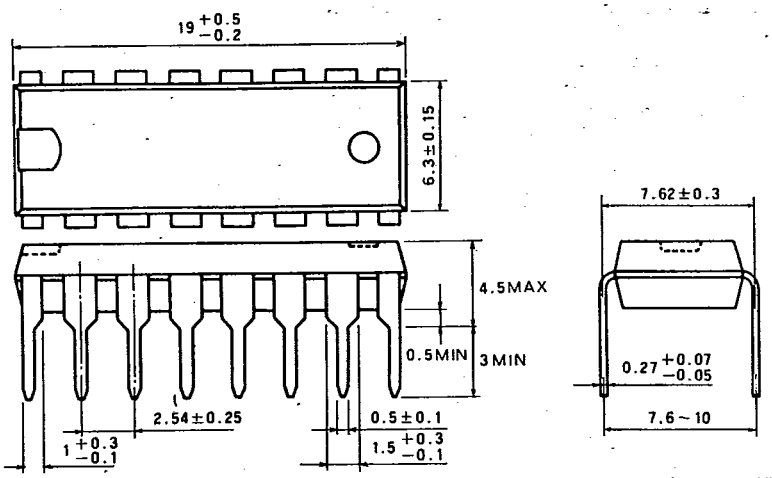
TYPE 14P4 14-PIN MOLDED PLASTIC DIL

Dimension in mm



TYPE 16P4 16-PIN MOLDED PLASTIC DIL

Dimension in mm



TYPE 20P4 20-PIN MOLDED PLASTIC DIL

Dimension in mm